Sensory Control of Prey Capture in *Navanax inermis*

BY

M. J. MURRAY [1] AND E. R. LEWIS

Department of Electrical Engineering and Computer Sciences, University of California
Berkeley, California 94720

(1 Plate; 1 Text figure)

INTRODUCTION

Navanax inermis (Cooper, 1862) is a carnivorous marine mollusk (Gastropoda; Opisthobranchia) whose diet consists mainly of fellow opisthobranchs. PAINE (1963) showed that this carnivore normally locates its prey by following their mucous trails. When *Navanax* first encounters the mucous trail of an acceptable prey species (BLAIR & SEAPY, 1972; PAINE, *op. cit.*) it turns onto and begins following the trail. After a correct turn onto the trail, *Navanax* usually will overtake the prey, and, upon contact, protract its large muscular pharynx and ingest the prey by means of a powerful pharyngeal sucking action (PAINE, *op. cit.*; BLAIR & SEAPY, *op. cit.*).

In this paper we present evidence that hunting by *Navanax* actually comprises 3 separate steps – stalking, prey recognition, and ingestion, and that each step is brought into the sequence automatically through the mediation of 3 localized sets of sensory organs. The sensory organs we associate with stalking and prey recognition consist of bundles of cilia that are retracted periodically into cylindrical sheaths, an action that may provide periodic cleansing of residual mucus from the sensory surfaces.

RESULTS

Sensory Areas Controlling Predation: Most, if not all, of the receptors responsible for the detection of prey trails and prey are found on *Navanax*' anterior frontal surfaces, which are depicted in Figure 1. This claim was suggested by our finding that turning onto a prey trail begins when the anterior parts encounter the trail, and that pharyngeal protraction is induced when the anterior surfaces encounter a prey specimen. Moreover, *Navanax* specimens will trail a small hand-held cotton swab which has been loaded with prey mucus, but only if the swab is applied to the frontal areas.

The latter observation provides the basis for more precise experiments designed to locate the sensory areas involved in prey capture. In these experiments, *Navanax* specimens were tethered in a sea water bath by hooks implanted in the anterior dorsum and tied to the walls of the aquarium. This rendered the anterior body sufficiently immobile that stimuli could be applied precisely (often with the aid of a dissecting microscope) to small local areas. Under these circumstances, many specimens displayed their usual responses to frontal stimulation with prey mucus or with pieces of prey animals. We used nudibranchs (*Hermissenda crassicornis* (Eschscholtz, 1831)) as sources of mucus for the cotton swabs and fresh pieces of prey. We ran trials at 1 to 2 minute intervals, testing left and right paired structures alternately where appropriate.

This type of testing revealed that, of the frontal anatomical structures depicted in Figure 1, only 3 mediated responses associated with predation. These are the paired anterior lateral folds (ALF's), the paired tentacles, and the lips of the pharynx. When prey mucus was applied to one or the other ALF the dominant response was to turn toward the side stimulated (96% of 58 trials in 6 specimens). When a swab lacking mucus was presented to the ALFs, significantly fewer turns occurred (28% of 65 trials in 6 specimens), the dominant behavior being to give no response at all. This shows that the mucus, rather than the swab bearing it, was the major source of turning behavior. [Our method of tethering prevents contact between the subjects and the substrate, a situation they appear to find noxious. We think the weak tendency to turn towards the mucus-free stimulus reflects the investigation of potential substrate.]

Living prey specimens, or fresh pieces thereof, also drove turning when presented to the ALFs (100% of 58 trials in 6 specimens) and sometimes elicited pharyngeal

[1] Present address: Department of Electrical Engineering, Princeton University, Princeton, New Jersey 08540

Figure 2A

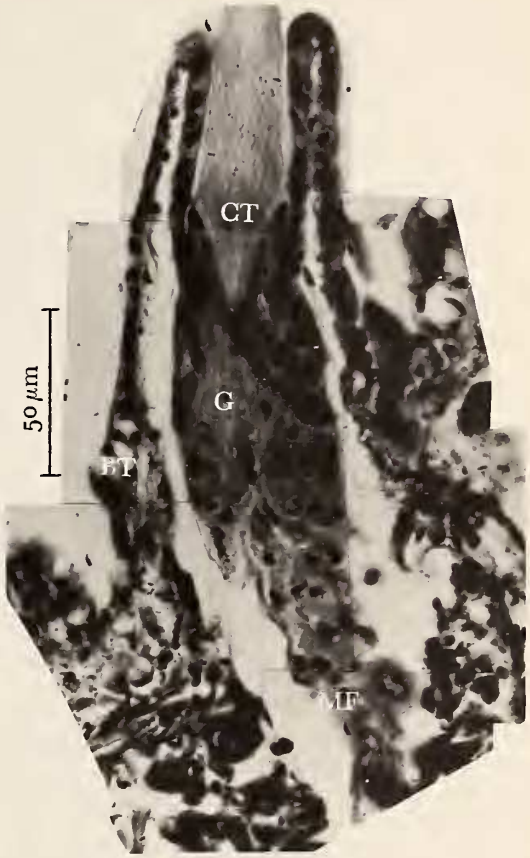

Figure 2B

Figure 2A: A scanning electron micrograph of a phalliform organ whose ciliary tuft is normally extended

Figure 2B: A phalliform organ in section, with the ciliary tuft withdrawn. Hematoxylin and eosin stain; 14 μm section

CT – ciliary tuft; BT – basal tube; G – ganglion; MF – muscle filament